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# EFFICACY OF DYNAMIC LUMBAR STABILIZATION EXERCISE IN LUMBAR MICRODISCECTOMY

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***Objective:*** **The aim of this study was to determine the efficacy of dynamic lumbar stabilization exercises in patients with lumbar microdiscectomy.**

***Design:*** **A prospective, randomized, controlled study.**

***Subjects:*** **Forty-two patients who were diagnosed as having lumbar disc herniation and had been operated on using the microdiscectomy method were divided randomly into 3 groups.**

***Methods:*** **Dynamic lumbar stabilization exercises were set for the first group and a home exercise programme for the second. The third group given no exercises was considered as a control group. All patients were examined twice, once before the exercise programme and once 8 weeks later.**

***Results:*** **Improvement in the first group was highly significant after the treatment ($p < 0.0001$). The second group improved significantly more in some parameters (pain, functional disability, lumbar Schober, progressive isoinertial lifting evaluation (neck), trunk endurance (flexion-extension)) than did the third group. The third group of patients showed some improvement in fingertip–floor distance, functional disability, modified lumbar Schober and left rotation in 8 weeks, but there were no significant improvements in the other parameters.**

***Conclusion:*** **Dynamic lumbar stabilization exercises are an efficient and useful technique in the rehabilitation of patients who have undergone microdiscectomy. They relieve pain, improve functional parameters and strengthen trunk, abdominal and low back muscles.**

*Key words:* discectomy, exercises, herniated disc, pain, muscle strength

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## INTRODUCTION

In industrialized countries, approximately 50–80% of the adult population have low back pain at some time in their lives (1, 2). Although there are many causes of low back pain, lumbar disc herniation is one of the most important. Low back pain is the most frequent reason for physical functional restriction in patients under 45 years of age and the third most frequent reason in people over 45 years of age (3). There are a range of different approaches to treatment of lumbar disc herniation, from physical fitness exercises to back surgery. Exercise therapy is one of the most important aspects of the functional restoration programme.

For years, flexion-extension exercises (Williams-McKenzie) were tried in patients with low back pain, while today new exercise methods are being used. Dynamic lumbar stabilization exercises are important in both the conservative treatment of lumbar disc herniation and in post-operative rehabilitation programmes (4). These exercises are done in the so-called neutral position where the segmental forces between disc and facet joints are best balanced and the most effective stability is obtained in axial tension strength. The neutral position is conserved during exercises and lumbar stability is not disturbed even in motion. While muscle strength is increased, improper tension is avoided in these exercises.

In this study, the efficacy of dynamic lumbar stabilization exercises was investigated in patients who had undergone a lumbar microdiscectomy operation.

## MATERIAL AND METHODS

In this open, prospective and controlled study we examined 42 patients who had undergone microdiscectomy between January and September 1998 in the Neurosurgery Clinics of Sisli Etfal and Taksim Education and Research Hospitals. Lumbar disc herniation was diagnosed using a clinical radiological (MRI) examination in the neurosurgery clinics. Patients were selected and categorized according to our inclusion criteria, as follows:

- age between 20 and 60 years
- undergoing the lumbar disc herniation operation for the first time
- being operated on at a single level
- being in the first post-operative month
- absence of a systemic disease (cardiovascular, infectious and/or metabolic disease that could interrupt exercises)
- absence of spinal stability problems (e.g. spondilolysis, spondilolisthesis)

Among the 42 patients selected, 22 were male and 20 female. The youngest of the patients was a 22-year-old male who was in the third group. The oldest patient was a 60-year-old male in the first group. The average ages of the patients were 46 years in the first group, 41 years in the second group and 43 years in the third. The average weights and heights are shown in Table I. There were no significant differences for age, weight and height between the groups (Table I).

The breakdown of patients' occupations is shown in Table I.

Patients were divided randomly into 3 treatment groups. Dynamic lumbar stabilization exercises were administered to the patients in the first group. Before the exercise programme, the soft tissue flexibility and range of motion of these patients were increased through stretching exercises, with 5–10 minute relaxation periods. The exercise programme was performed 3 days a week with 5 repetitions in 3 sets to begin with

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Table I. *Demographic features and professions of patients*

| | First group | Second group | Third group |
|---|---|---|---|
| Number | 14 | 14 | 14 |
| Sex (M/F) | 8/6 | 6/8 | 8/6 |
| Age (years) | 46.00 ± 9.77 | 41.00 ± 8.88 | 42.79 ± 11.39 |
| Weight (kg) | 73.29 ± 13.00 | 74.50 ± 7.43 | 75.86 ± 9.36 |
| Height (cm) | 166.64 ± 6.91 | 167.50 ± 8.04 | 167.29 ± 10.50 |
| Housewife | 4 | 6 | 4 |
| Driver | 2 | 2 | 0 |
| Teacher | 0 | 1 | 0 |
| Retired | 2 | 0 | 3 |
| Civil servant | 1 | 0 | 1 |
| Student | 0 | 0 | 1 |
| Technical worker | 5 | 4 | 5 |

and repetitions were gradually increased until they reached 15. Exercises were conducted under the supervision of a physiotherapist who instructed the patients initially on an individual basis. They initially performed the exercises individually as well. After the basic steps had been covered successfully, patients carried out the exercises in groups of 2 or 3 for the duration of the programme. During the exercises the importance of neutral spinal position was repeatedly stressed. The entire programme lasted 8 weeks.

The second group of patients received a home exercise programme. Flexion and extension (Williams-McKenzie), pelvic tilt and exercises for strengthening abdominal and trunk muscles were demonstrated by a physician and patients received a written outline and description of the exercise programme. Patients were told to carry out the exercises 3 days a week; the first week 5 repetitions, the second week 10 repetitions, and after that 15 repetitions for the remainder of the 8-week programme. All the patients were reminded to carry out the exercises regularly.

The third group was the control group with no exercise programme.

All of the patients in the 3 groups were examined at the end of the first post-operative month and at the end of the third post-operative month. In the first interview all of the patients in the first and second groups were told that the aim of the programme was to relieve pain, increase functional capacity, help them reacclimatize to daily life and prevent reherniation.

The evaluated parameters were as follows: pain (by VAS) (5–8), functional capacity (by modified Oswestry index (MOI)) (7, 9–12), depression (by Beck Depression Scale (BDS)) (7, 13), spinal mobility (fingertip–floor distance (FFD), lumbar Schober (LS), modified lumbar Schober (MLS) (14, 15), lumbar extension (LE), lateral flexion (LF) and rotation, weight lifting capacity (by progressive isoinertial lifting evaluation (PILE) test) (16) and body strength (17). Any presence of scoliosis and/or paravertebral muscular spasm was noted during the physical examination. A neurological examination was also included. The statistical analysis of the results was done using INSTAT packet programme of statistics. Double variant interpretation was carried out with a *t*-test; triple group interpretation was carried out with one-sided variant analysis; multiple group interpretation was carried out by Tuckey Kramer testing. *p*-values lower than 0.05 were considered significant.

## RESULTS

The most common level of disc herniation was between L4 and L5 (45.24%, 19 patients), while L5–S1 was the second most common (42.85%, 18 patients). During the initial examination of the patients there were no differences between the 3 groups in terms of pain, functional capacity, depression, fingertip–floor distance, LS, MLS, LE, LF, rotation and PILE (neck) scores. Prior to exercise PILE (back) and body strength scores in the first group were worse than those in the other groups (Table II).

The examination of the patients in the first group at completion of the exercise programme showed significant improvement ($p < 0.0001$–$0.0004$) had occurred in all parameters (Table III).

The examination of patients in the second group after the exercise programme showed moderate improvement had occurred in all parameters (Table IV).

The examination of the control group patients, after the 8-week period, showed improvement in functional capacity, fingertip–floor distance, modified lumbar Schober and in left rotation, while in the other parameters there were no significant differences (Table V).

When we compare the groups' results we see that the first

Table II. *The groups' characteristics during the first examination*

| | First group | Second group | Third group | F |
|---|---|---|---|---|
| Pain (VAS) | 4.29 ± 1.07 | 4.64 ± 1.39 | 4.50 ± 1.23 | 0.2962 |
| MOI | 21.86 ± 7.64 | 20.71 ± 5.84 | 21.07 ± 7.26 | 0.09899 |
| BDS | 10.43 ± 6.00 | 7.29 ± 5.41 | 7.50 ± 5.74 | 1.320 |
| FFD (cm) | 41.36 ± 6.18 | 39.21 ± 13.18 | 37.57 ± 0.02 | 0.3705 |
| LS (cm) | 2.79 ± 0.86 | 3.25 ± 0.70 | 3.45 ± 0.87 | 2.381 |
| MLS (cm) | 3.70 ± 0.85 | 4.06 ± 1.03 | 4.42 ± 0.97 | 1.996 |
| LE (°) | 16.07 ± 4.46 | 21.43 ± 7.19 | 20.00 ± 8.55 | 2.235 |
| Right LF (cm) | 15.00 ± 4.89 | 15.61 ± 3.21 | 15.00 ± 3.49 | 0.1113 |
| Left LF (cm) | 15.46 ± 3.99 | 15.07 ± 2.92 | 16.32 ± 3.85 | 0.4375 |
| Right R (cm) | 3.86 ± 1.99 | 3.64 ± 1.90 | 3.43 ± 2.03 | 0.1651 |
| Left R (cm) | 4.00 ± 1.47 | 3.64 ± 1.47 | 3.43 ± 2.27 | 0.3695 |
| PILE (back) (kg) | 7.14 ± 3.78[a] | 13.39 ± 7.76 | 13.75 ± 5.94 | 5.280 |
| PILE (neck) (kg) | 11.07 ± 4.35 | 15.54 ± 7.28 | 14.64 ± 5.54 | 2.283 |
| Body strength (F) | 32.07 ± 26.89[b] | 39.43 ± 26.81 | 65.00 ± 48.87 | 3.278 |
| Body strength (E) | 22.64 ± 14.52[b] | 32.36 ± 17.57 | 49.93 ± 38.51 | 4.012 |

[a] Statistically significant ($p < 0.05$) compared with the other 2 groups.
[b] Statistically significant ($p < 0.05$) compared with the third group only.
VAS: visual analogue scale; MOI: modified Oswestry index; BDS: Beck depression scale; FFD: fingertip-floor distance; LS: lumbar Schober; MLS: modified lumbar Schober; LE: lumbar extension; LF: lateral flexion; R: rotation; PILE: progressive isoinertial lifting evaluation; F: flexion; E: extension.

Table III. *Results of the evaluated parameters in the first group in post-operative 1st and 3rd months*

| | Post-operative first month | Post-operative third month | T |
|---|---|---|---|
| Pain (VAS) | 4.29 ± 1.07 | 1.14 ± 0.86 | 17.737 |
| MOI | 21.86 ± 7.64 | 8.50 ± 4.83 | 9.901 |
| BDS | 10.43 ± 6.00 | 6.07 ± 7.45 | 3.164 |
| FFD (cm) | 41.36 ± 6.18 | 14.57 ± 8.01 | 18.983 |
| LS (cm) | 2.79 ± 0.86 | 3.83 ± 0.66 | 8.548 |
| MLS (cm) | 3.70 ± 0.85 | 5.29 ± 1.15 | 7.20 |
| LE (°) | 16.07 ± 4.46 | 23.21 ± 4.21 | 5.701 |
| Right LF (cm) | 15.00 ± 4.89 | 18.7 ± 3.85 | 5.286 |
| Left LF (cm) | 15.46 ± 3.99 | 18.89 ± 4.35 | 7.366 |
| Right R (cm) | 3.86 ± 1.99 | 6.21 ± 1.82 | 4.756 |
| Left R (cm) | 4.00 ± 1.47 | 6.46 ± 1.76 | 4.787 |
| PILE (back) (kg) | 7.14 ± 3.78 | 12.32 ± 3.86 | 7.233 |
| PILE(neck) (kg) | 11.07 ± 4.35 | 15.36 ± 4.48 | 7.019 |
| Body strength (F) | 32.07 ± 26.89 | 76.21 ± 41.75 | 6.418 |
| Body strength (E) | 22.64 ± 14.52 | 68.29 ± 24.44 | 7.077 |

VAS: visual analogue scale; MOI: modified Oswestry index; BDS: Beck depression scale; FFD: Fingertip-floor distance; LS: lumbar Schober; MLS: modified lumbar Schober; LE: lumbar extension; LF: lateral flexion; R: rotation; PILE: progressive isoinertial lifting evaluation; F: flexion; E: extension.

Table V. *Results of the evaluated parameters in the third group in post-operative 1st and 3rd months*

| | Post-operative first month | Post-operative third month | T |
|---|---|---|---|
| Pain (VAS) | 4.50 ± 1.23 | 4.29 ± 1.90 | 0.7148 |
| MOI | 21.07 ± 7.26 | 17.71 ± 6.23 | 2.966 |
| BDS | 7.50 ± 5.74 | 6.36 ± 4.22 | 0.9642 |
| FFD (cm) | 37.57 ± 14.02 | 30.50 ± 14.17 | 2.912 |
| LS (cm) | 3.45 ± 0.87 | 3.51 ± 0.70 | 0.5429 |
| MLS (cm) | 4.42 ± 0.97 | 4.67 ± 0.94 | 2.33 |
| LE (°) | 20.00 ± 8.55 | 20.36 ± 8.65 | 0.5631 |
| Right LF (cm) | 15.00 ± 3.49 | 15.64 ± 4.29 | 1.152 |
| Left LF (cm) | 16.32 ± 3.85 | 16.71 ± 3.80 | 0.5797 |
| Right R (cm) | 3.43 ± 2.03 | 4.18 ± 1.96 | 3.587 |
| Left R (cm) | 3.43 ± 2.27 | 3.97 ± 1.89 | 2.723 |
| PILE (back) (kg) | 13.75 ± 5.94 | 13.93 ± 5.69 | 1.000 |
| PILE (neck) (kg) | 14.64 ± 5.54 | 15.00 ± 5.55 | 1.472 |
| Body strength (F) | 65.00 ± 48.87 | 59.64 ± 45.43 | 1.405 |
| Body strength (E) | 49.93 ± 38.51 | 49.57 ± 38.11 | 0.1779 |

* $p$ value <0.05; ** $p$ value <0.01.

VAS: visual analogue scale; MOI: modified Oswestry index; BDS: Beck depression scale; FFD: fingertip-floor distance; LS: lumbar Schober; MLS: modified lumbar Schober; LE: lumbar extension; LF: lateral flexion; R: rotation; PILE: progressive isoinertial lifting evaluation; F: flexion, E: extension.

group improved more than the other 2 groups in all the parameters except depression. The second group improved more than the control group in most parameters (pain, functional capacity, LS, PILE (neck), body strength (F-E)) (Table VI).

At the end of the follow-up period the physical and neurological progress of the patients was satisfactory. Abolished deep tendon reflexes did not recover. Among 10 patients with paravertebral muscular spasm, spasm had disappeared in 1. Among 8 patients with sensory deficit, 3 became asymptomatic. Four of the 8 patients with motor deficits showed healing in motor loss. In the second group only 1 patient with paravertebral muscular spasm and another patient with sensory deficit improved, while the others remained the same. The patients' progress was satisfactory. In the third group none of the patients with paravertebral spasm, sensory or motor deficit improved. In addition, at the second control the number of patients with sensory deficit and paravertebral spasm increased (Table VII).

## DISCUSSION

It is known that approximately 25% of patients who have been operated on for lumbar disc herniation have post-operative complaints. It is also known that in operated and non-operated

Table IV. *Results of the evaluated parameters in the second group in post-operative 1st and 3rd months*

| | Post-operative first month | Post-operative third month | T | $p$ |
|---|---|---|---|---|
| Pain (VAS) | 4.64 ± 1.39 | 2.93 ± 2.02 | 3.809 | <0.01 |
| MOI | 20.71 ± 5.84 | 12.93 ± 4.23 | 5.458 | <0.0001 |
| BDS | 7.29 ± 5.41 | 6.21 ± 4.92 | 2.259 | <0.05 |
| FFD (cm) | 39.21 ± 13.18 | 26.29 ± 10.65 | 4.295 | <0.001 |
| LS (cm) | 3.25 ± 0.70 | 3.77 ± 0.67 | 4.500 | <0.001 |
| MLS (cm) | 4.06 ± 1.03 | 4.85 ± 0.80 | 3.86 | <0.01 |
| LE (°) | 21.43 ± 7.19 | 24.64 ± 7.20 | 3.229 | <0.01 |
| Right LF (cm) | 15.61 ± 3.21 | 17.46 ± 3.47 | 5.316 | <0.0001 |
| Left LF (cm) | 15.07 ± 2.92 | 16.79 ± 3.31 | 2.541 | <0.05 |
| Right R (cm) | 3.64 ± 1.90 | 4.54 ± 1.81 | 4.692 | <0.001 |
| Left R (cm) | 3.64 ± 1.47 | 4.50 ± 1.45 | 3.379 | <0.01 |
| PILE (back) (kg) | 13.39 ± 7.76 | 15.18 ± 7.56 | 3.238 | <0.01 |
| PILE (neck) (kg) | 15.54 ± 7.28 | 18.21 ± 7.37 | 4.837 | <0.001 |
| Body strength (F) | 39.43 ± 26.81 | 52.07 ± 23.75 | 3.120 | <0.01 |
| Body strength (E) | 32.36 ± 17.57 | 50.79 ± 24.63 | 3.588 | <0.01 |

VAS: visual analogue scale; MOI: modified Oswestry index; BDS: Beck depression scale; FFD: fingertip-floor distance; LS: lumbar Schober; MLS: modified lumbar Schober; LE: lumbar extension LF: lateral flexion; R: rotation; PILE: progressive isoinertial lifting evaluation; F: flexion; E: extension.

Table VI. *Comparison of the in-group differences*

| | First group | Second group | Third group | F |
|---|---|---|---|---|
| Pain (VAS) | $3.14 \pm 0.66^{a}$ | $1.71 \pm 1.68^{b}$ | $0.21 \pm 1.12$ | 19.870 |
| MOI | $13.36 \pm 5.05^{a}$ | $7.79 \pm 5.34^{b}$ | $3.14 \pm 3.63$ | 16.353 |
| BDS | $3.57 \pm 4.72$ | $1.07 \pm 1.77$ | $1.14 \pm 4.44$ | 1.887 |
| FFD (cm) | $26.79 \pm 5.28^{a}$ | $12.93 \pm 11.26$ | $7.07 \pm 9.09$ | 18.145 |
| LS (cm) | $0.96 \pm 0.45^{a}$ | $0.52 \pm 0.43^{b}$ | $0.06 \pm 0.44$ | 14.420 |
| MLS (cm) | $1.59 \pm 0.83^{a}$ | $0.79 \pm 0.76$ | $0.25 \pm 0.42$ | 13.313 |
| LE (°) | $7.14 \pm 4.69^{a}$ | $3.21 \pm 3.73$ | $0.36 \pm 2.37$ | 11.752 |
| Right LF (cm) | $3.79 \pm 2.68^{b}$ | $1.86 \pm 1.31$ | $0.64 \pm 2.09$ | 7.961 |
| Left LF (cm) | $3.43 \pm 1.74^{b}$ | $1.71 \pm 2.53$ | $0.39 \pm 2.54$ | 6.144 |
| Right R (cm) | $2.36 \pm 1.86^{a}$ | $0.89 \pm 0.71$ | $0.75 \pm 0.78$ | 7.290 |
| Left R (cm) | $2.46 \pm 1.93^{a}$ | $0.86 \pm 0.95$ | $0.54 \pm 0.75$ | 8.633 |
| PILE (back) (kg) | $5.18 \pm 2.68^{a}$ | $1.79 \pm 2.06$ | $0.18 \pm 0.67$ | 23.032 |
| PILE (neck) (kg) | $4.64 \pm 1.34^{a}$ | $2.68 \pm 2.07^{b}$ | $0.36 \pm 0.91$ | 28.005 |
| Body strength (F) | $44.14 \pm 25.74^{a}$ | $12.64 \pm 15.16^{b}$ | $-5.36 \pm 14.27$ | 24.063 |
| Body strength (E) | $45.64 \pm 24.13^{a}$ | $18.43 \pm 19.22^{b}$ | $-0.36 \pm 7.51$ | 22.285 |

[a] Statistically significant compared with the other 2 groups.
[b] Statistically significant compared with the third group.
VAS: visual analogue scale; MOI: modified Oswestry index; BDS: Beck depression scale; FFD: fingertip-floor distance; LS: lumbar Schober; MLS: modified lumbar Schober; LE: lumbar extension; LF: lateral flexion; R: rotation; PILE: progressive isoinertial lifting evaluation; F: flexion; E: extension.

patients there is lumbar, abdominal and dorsal muscle weakness (15, 18). Kahanowitz et al. have reported that the trunk muscles' strength is decreased about 30% after discectomy operation (19). Hence, both operated and non-operated low back patients need to follow an exercise programme for the relief of their painful backs.

Our knowledge about the effects of different types of exercise programmes on low back pain is quite limited. Many reports are listed in the literature on the overall effects of exercises in these cases. However, comparisons of the overall effects of different exercise programmes are confusing. Kendall & Jenkins (20) and Lidstrom & Zachrisson (21) indicated that spinal flexion exercises yielded better clinical results than spinal extension exercises in the treatment of low back pain patients. McKenzie (22) emphasized that extension exercises are more suitable for low back pain treatment than flexion exercises. In contrast, El Naggar et al. (23) emphasized that in the treatment of mechanical low back pain both flexion and extension exercises are effective methods and both could be used to increase spinal mobility and reduce pain. Manniche et al. examined the effectiveness of intensive dynamic extension exercises with controlled studies. At the end of the treatment period and after 3 months of follow-up they found a statistically significant difference between the 2 groups. After 1 year of follow-up it was concluded that the intensive exercise programmes should be carried out for longer periods of time (24, 25).

There is also little knowledge about post-operative rehabilitation programmes, especially about dynamic lumbar stabilization exercises. Manniche et al. (26) have examined 96 patients who were operated on for lumbar disc herniation for the first time. In their study the first group received a 6-week programme of dynamic lumbar and abdominal exercises while the second group was mobilized by a more general and moderate level of exercise programme. The exercise programme started in the fifth post-operative week. In the 26th week the work capacity and pain scores were better in the first group than in the second. At the end of the 52nd week there was no significant difference between the 2 groups. They concluded that intensive dynamic exercises should start as early as possible after the operation and last for a longer period to obtain better results. In our study we also started the exercise programme in the fifth post-operative week. In the 12th week, control results of dynamic lumbar stabilization exercises were significantly better for pain, function and mobility. Due to technical insufficiencies, microdiscectomy cannot be undertaken by the majority of surgeons in our region. Hence, we realize that we need a larger group of patients. However, the patient number was taken into consideration during the statistical analysis.

In another study by Manniche et al. (27) 62 patients who had chronic pain after 24–60 months following discectomy operation were divided into 2 groups. The first group started on the exercises with hyperextension, while the second started a programme with no hyperextension. After 1 year there was no significant difference between the 2 groups for pain and disability. In both groups the isometric strength of dorsal muscles increased. In the hyperextension group, in particular, lumbar flexibility (modified Schober test) improved. Our study revealed that both the home exercise group and the dynamic lumbar stabilization group improved significantly in both body flexion and extension strengths and PILE lifting parameters. Furthermore, the overall results in the dynamic stabilization group were significantly superior than in the other two study groups.

In conclusion, there is improvement in pain, functional capacity, body strength, mobility and weight lifting capacity after a lumbar microdiscectomy operation if the patients follow

an exercise programme. Of the various exercises for low back pain, dynamic lumbar stabilization exercises give the best results. They are especially effective in the post-operative rehabilitation of patients after microdiscectomy operation. Although home exercises are also beneficial, dynamic lumbar exercises carried out under the supervision of an experienced helper are more effective in reducing pain and increasing functional capacity and the strength of abdominal, lumbar and trunk muscles.

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